Indian J. Phys. **64B** (2), 125-128 (1990)

Radiorefractivity change due to severe weather

T R Sivaramakrishnan
Meteorology Facility, ISRO, Sriharikota-524 124, India
and
T R Thiaga Rajan
Texas Southern University, Houston, Texas, USA

Received 24 July 1989, accepted 1 November 1989

Atmospheric conditions affect the radio wave propagation. Since certain severe weather systems bring about drastic changes in the atmospheric parameters, the effects are manifested in its radio horizon and signal strength variations. Sometimes trapping of radio wave occurs. The quantitative information on these variations is of vital importance to radiophysicists especially for VHF and microwave communications. According to CCIR study group V, unit change in radio refractive index results in a change of 0.2 db in field strength.

The seasonal variations of radio refractivity over India and adjoining sea areas have been established by Kulshrestha and Chatterji (1966) and Sivaramakrishnan (1981, 1982, 1987a). Diurnal changes at certain places in India have also been established recently (Deshpande 1974, Pradhan and Dayakishan 1977, Sivaramakrishnan 1985, 1987b). However, temporal variations occur suddenly due to severe meteorological phenomena. A quantitative study of changes due to such phenomena is of much relevence and use to the engineers. Such a study has been conducted at Sriharikota in east coast of India, and the results are presented here.

Sriharikota (13.7 degrees N 80.2 degrees E) is a coastal station in the tropical region. Cyclones and thunderstorms are two major weather events over Tropical belts. The meteorological parameters monitored during four different cyclones during 1979 to 1987 which have affected Sriharikota, were considered and the radio refractive index was worked out for each hour. The trends are examined and discussed.

About 11 thunderstorm occasions during April to September 1988 were critically monitored. Radio refractive index was computed for conditions before and after the occurrence of thunderstorm. The changes noted are discussed. The detailed methodology of computation of RRI from the meteorological parameters are

explained by Sivaramakrishnan (1989) and the same method has been used for this investigation also.

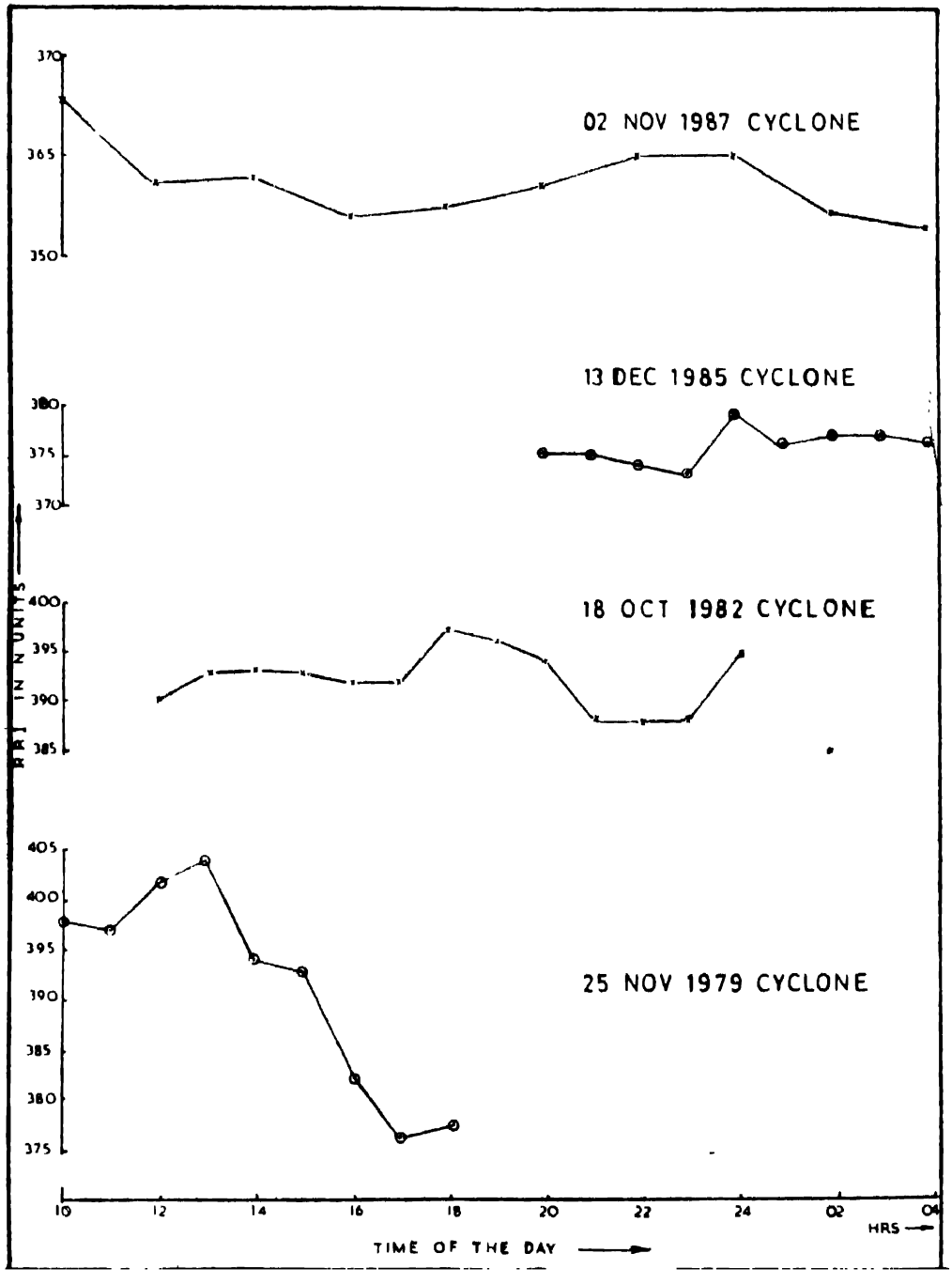

Figure 1. Radiorefractivity during cyclones.

Figure 1 presents the variation of the radio refractive index when the station was under the influence of four cyclones. It can be seen that during November 1979 cyclone, the variation is 18 *N* units and in November 1987, it was 13 *N* units. Never-theless, in the other two cases the variation is within 10 *N* units. The mean diurnal variation of RRI is low and arround 11 only during November/December over this place as per an earlier study (Sivaramakrishnan 1988) and it is arround 15 for October. Thus the RRI variation associated with a cyclone appears to be considerable in November than in the other months (October and December). The monthly mean value of RRI is 382 for October and 374 for November over this place. Thus, we can say that the quantitative variation of RRI due to cyclone is about 3 to 5% of normal value in November. Another point to be noted is that in November 1979 cyclone period, the island was under the cyclonic influence mostly during daytime where as in other cases the island felt the cyclonic effect mostly during night.

The details of radio refractive index measured in connection with thunderstorm phenomenon are presented in Table 1. The first point to note is that in majority

Table 1. Variation of RRI with thunderstorm.

Date	Time Hours	Radio refractive index		Change
		before thunderstorm	after	
17-4-88	1030	372	364	-8
21-4-88	2025	382	377	-5
18-5-88	2045	385	374	-11
25-5-88	0530	386	380	-6
01-6-88	0600	366	369	+3
02-6-88	0120	379	393	+14
21-6-88	2027	377	377	0
03-7-88	0300	369	371	+2
19-7-88	2145	389	384	-5
17-8-88	0205	394	391	-3
25-9-88	0400	390	378	-12

of the cases there is a fall of RRI. The changes are brought at out suddenly with the occurrence of thunderstorm. That is as soon as the energy release from the convective cloud occurs either in the form of rain shower or squall winds or both, the change occurs. This is found to reflect in the signal strength/fading of any radio equipments. The change is as low as 0 or 3 and can go upto 14 *N* units. The extent of change in RRI does not seem to be related to the time of the day

when thunder occurs. Rather the intensity of the convective storm may be responsible for the extent of the change brought about.

Generally the diurnal variation is found to be more (20 to 30 *N* units) in the southwest monsoon months of June to September. The maximum variation figure of 14 associated with the thunderstorm may not apparently look significant. But it must be remembered that while the diurnal variation follows a definite trend during different periods of the day and night, the change due to the thunderstorm is sudden and rather sharp.

Thus, while the change in RRI associated with the cyclone over a place is steady, the change is sudden and sharp in association with the thunderstorm. The change varies upto about 14 *N* units in thunder occassions but can go to the extent of 28 *N* units in association with a cyclone. These may be useful information to radio and communication engineers in two ways—

(1) as a general information regarding the quantitative potential of severe weather to affect the radio waves.

(2) for immediate applications locally as many equipments like radar, telemetry as well as communication equipments using VHF and microwave frequencies function from this rocket launching centre.

References

Deshpande C V 1974 *Indian J. Met. Geophys.* **25** 301
Kulshrestha S M and Chatterji K 1966 *Indian J. Met. Geophys.* **17** 467
Pradhan S K and Dayakishan S 1977 *Indian J. Met. Hyd. and Geophys.* **28** 400
Sivaramakrishnan T R 1981 *Mousam* **32** 27
—— 1982 *Mousam* **33** 21
—— 1985 *Vayumandal* **147**
—— 1987a *Mousam* **38** 360
—— 1987b *Mousam* **38** 352
—— 1988 ISRO-SHAR-TN-50-88 June 1988
—— 1989 *Indian J. Phys.* (Accepted for publication)